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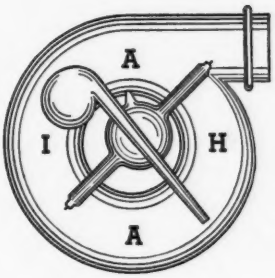

VOLUME 7 JUNE, 1946 NUMBER 2

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ROBERT A. KEHOE, M.D., President of the A.I.H.A. over the past year, clarifies the roles to be played by the several elements engaged in furthering industrial health, on the basis of his intimate knowledge of all phases of this broad field. . . . INDUSTRIAL hygiene, new as it is, has an interesting history, as to which ROBERT T. LEGGE, M.D., leads off with an informative chapter. . . . A UNIQUE industrial hygiene program including a number of elements which must necessarily promote its effectiveness is that of the American Can Company, presented here in some detail by MR. L. V. TAYLOR . . . . IT IS refreshing to receive such a well conceived program of education and training of an industrial hygiene engineer as that of GEORGE W. REID, of the Georgia School of Technology. . . . CAREFUL study should be accorded the analytical paper by PAUL D. HALLEY. HALLEY'S recommendations for more uniform procedures deserve close attention by those engaged in dust determination. The photographs illustrating this paper were made by CHARLES WYMAN, Industrial Hygienist of the Western Electric Company. . . . PRACTICAL notes of much value to the ventilation man are given by MR. H. H. VALIQUET, based on his broad experience in working with such problems.

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION QUARTERLY, an Official Publication of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, published quarterly (March, June, September, December) by INDUSTRIAL MEDICINE PUBLISHING COMPANY, Chicago (publishers also of INDUSTRIAL MEDICINE, issued monthly, and INDUSTRIAL NURSING, issued monthly). STEPHEN G. HALOS, President; A. D. CLOUD, Publisher; WARREN A. COOK, Editor; CHARLES DRUECK, JR., Secretary and Treasurer; STEPHEN G. HALOS, Advertising and Business Manager. PUBLICATION, EDITORIAL and EXECUTIVE Offices, 605 North Michigan Avenue, Chicago 11, Illinois. Subscription $2.00 per year in the United States; $2.50 per year in Canada; $3.00 per year in other countries. Single copies 75 cents. Copyright, 1946, by Industrial Medicine Publishing Company, Chicago. Eastern Representative, H. GORDON HUNTER, 152 West Tenth Street, New York City 14, Telephone Watkins 9-1067.

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AMERICAN
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QUARTERLY

Volume 7 JUNE, 1946 Number 2

A Historical Background of Industrial Hygiene

ROBERT T. LEGGE, M.D.,
University of California,
Berkeley

FOR MANY years I have been a bibliophile, a collector of items in the history of medicine, especially of books whose contributors added progress to medical science. When your secretary invited me to attend your society to address you, I was in the act of preparing my material for publication on 20 centuries of history on lead poisoning, the first and oldest occupational disease. It dawned upon me that instead of presenting an academic research article, it would be more relaxing and of more educational value to point out some historic events in lead poisoning that are memorable in your field of industrial hygiene.

As hygienists, you hold an important place in industry and public health in the control of occupational and traumatic diseases primarily the result of chemical and physical agents. Through your training and knowledge of certain basic sciences and in cooperation and consultation with the plant physician you have introduced engineering principles, safety and sanitary sciences, toxicology and control tests, to develop an environment as a safe place for the worker; this is a job that demands eternal vigilance to curtail morbidity and mortality, with emphasis on logical reasoning and observation. Similarly the science of epidemiology is to control and prevent communicable diseases caused by bacteria, virus, and other pathological organisms, by early recognition of symptoms among exposed and diseased workers, to discover contacts, to introduce isolation, disinfection and immunizing measures.

Presented before the MICHIGAN INDUSTRIAL HYGIENE SOCIETY, Detroit, May 20, 1946.

Industrial hygiene and industrial epidemiology are absolutely essential in preventive industrial medicine and cannot be divorced.

Occupational diseases have the same symptoms and signs as are observed in infectious diseases, such as headache, dizziness, pallor, nausea, vomiting, collapse, and skin irritation. In occupational diseases these symptoms are due to chemical poisons which affect the physiology of the worker, while in the case of infectious diseases, the toxemia that produces the morbid signs is the result of micro-organisms gaining entrance through the portals of the body.

The physician and the hygienist must, therefore, know the signs and symptoms of poisoning of each chemical agent used in the various plant processes, and particularly the earliest signs, for this is the period in which to prevent advanced pathology with all the consequences that it entails.

It is contended that the industrial dispensary should be open to its employees for all medical cases so that the physician may be on the alert to differentiate early occupational disease from infectious disease. This is the only sound method of practicing industrial hygiene and epidemiology. By such measures clews are afforded for the detection of leaks through which toxic agents are polluting the worker's environment, for discovering contacts, and for correction of the etiological factors. The same sleuthing procedure is practiced in epidemic diseases, as a public health measure and for curative medicine.

These preliminary remarks are offered as a review of what our modern industrial

hygienists and physicians are, or should be, practicing in the twentieth century, in contrast to discussion of the three personages who made important contributions in the history of lead poisoning, now to be introduced. Living as they did before the days of bacteriology and other modern sciences, by their keen observations, surveys, and logical deductions, their names have become immortal. My story opens with the greatest engineer in ancient times, and probably the first industrial hygienist.

Vitruvius

OF THE earliest of the Roman writers and observers, the foremost was Vitruvius Pollio (70-16 B.C.) born at Verona. A famous Roman architect and engineer under Augustus and Caesar, he wrote a series of 10 volumes on engineering and architecture, comprising all the Greek and Roman learning upon these subjects. He was first to describe chronic lead poisoning which he named plumbism, derived from the Latin word, *Plumbum*. He observed that this effect was the result of drinking water collected from lead-covered roofs, pipes, and storage cisterns. Our modern word plumber comes from the Roman word for a lead worker. He was first to describe the manufacture of red lead, which he called Sandaraca, as the heating of white lead by the force of fire. This keen observer also warned the Romans that in several localities their drinking water was the cause of goitre.

Benjamin Franklin on Lead Poisoning

BENJAMIN FRANKLIN (1706-1790) was America's first great scientist, printer, publisher, and statesman, a signer of the Declaration of Independence, and a member of the Constitutional Convention; he was an original genius, philosopher, inventor, and research worker. Among his contributions he proved through his kite experiment that lightning was electricity and named the two forms of electricity, positive and negative. He developed the Franklin stove, lightning rod, bi-focal spectacles, and described lead poisoning as an industrial malady of the print shop, and claimed that the West India gripes in 1786 was lead colic due to drinking Jamaica rum which was distilled from stills in which the still heads and worms were made of lead. As a result of his investigation of this fact and of giving it wide publicity, the Legislature of Massachusetts thereupon passed an act prohibiting, under severe penalties, the use of lead still heads and worms. This was probably the first legislation in industrial hygiene in America.

In one of his letters to his friend, Benjamin Vaughan, he relates: "In 1724 being in London I went to work in a printing house as a compositor. I there found a practice I had never seen before, that of drying a case of types (which is wet in distribution) by placing it sloping before a fire. I found this had the advantage, when the types were not dry'd but heated, of being comfortable to the hands when working over them in cold weather. I therefore sometimes heated my case when the types did not want drying. But an old workman, observing it, advised me not to do so, telling me I might lose the use of my hands by it as two of our companions had nearly done; one of whom use'd to earn his guinea a week could not make more than ten shillings, and the other, who had the dangles, but seven and six pence. This with a kind of obscure pain that I sometimes felt, as if it were the bones of my hand, when working over type made very hot, induced me to omit the practice."

In this same office he inquired whether the workers laboring over the furnaces of melted lead were not subject to that disorder, but the employer made light of any danger from effluvia and ascribed it to particles of the metal that were swallowed with their food by slovenly workmen who went to their meals after handling the metal without washing their fingers. This appeared to have some reason in it. But the pain Franklin experienced made him still afraid of these "effluvia."

In this same letter he stated that while in Derbyshire he was informed that the smoke from the lead smelting furnaces was pernicious to the neighboring grass and vegetables but never learned whether such vegetables affected animals who devoured them. It may be well to make such an inquiry. He also relates that a whole family was afflicted with a dry bellyache or colica Pictonum by drinking rain water which was collected from a lead-covered roof.

In 1767 while in Paris with Sir John Pringle he visited the famous *La Charite*,

a hospital particularly famous for the cure of this malady. It is striking to note the interest he had in lead poisoning and the careful and correct reasoning of America's first scientist.

The Story of the Devonshire Colic

MY FRIEND, the late Sir Arthur Newsholme, M.D., formerly principal medical officer of the local government board of England, in his book on the "Evolution of Preventive Medicine"—which shows the value of chemistry in an epidemiological investigation — summarizes Sir George Baker's classical "Essay Concerning the Cause of Endemial Colic of Devonshire," which was delivered at the College of Physicians at London in June, 1761, and published in 1767. Sir George Baker, M.D., F.R.S., (1722-1809) a Devonshire man, reviewed the historical accounts of the Devonshire Colic. Musgrave in 1603 had ascribed it to the effect of crude and sharp cider. Huxham in 1739 gave an account by stating that it infests Devonshire each autumn and that there was an exceptional incidence in 1724 when apples were especially abundant.

Huxham believed the colic was due to an acid salt or tartar contained in the apple juice. Baker reasoned that clinically there was not the least analogy between the juice of apples and the poison of lead and that the colic of Devonshire was precisely the same disease which was the specific effect of all saturnine preparations. It is unlikely that two causes, so different in their character as tartar and lead, should produce similar impressions on the human body.

And then he completed his chain of induction with the statement that if tartar was the cause of Devonshire colic, why is it that the inhabitants of Gloucestershire, Worcestershire, and Herefordshire who drink much cider do not suffer from colic? Why do lead miners receive such benefit from cream of tartar which is supposed to cause colic? Why is it that colic is no longer epidemic in Poitou where the local wine is still being drunk?

To sum up, Baker arrived at the preliminary conclusion that Devonshire colic was not due to pure cider but to either a fraudulent or accidental adulteration, and accordingly as a true investigator he first found that the colic was more common throughout Devonshire than in other parts of England. He ascertained that from September, 1762, to July 6, 1767, there were admitted in the Exeter Hospital 285 patients with colic and paralysis, while in the Bath Hospital the proportion of such patients from Devonshire to that from the counties of Hereford, Gloucester, and Worcester was generally eight to one. He then proceeded to make a survey of the cider mills and found that the moor stones in the circular troughs in which the apples were crushed were clamped together with iron and held by lead. In some cases the unequal areas were surfaced with lead and in some parts of the county the presses were lined with that metal. Some makers of cider placed leaden weights in the casks containing cider to prevent the liquor from becoming sour. Baker noted in three other counties the construction of the mill stones and the use of lead differed, and as a result there was a lesser prevalence of colic.

He then proceeded by critical testing to ascertain whether chemical analysis would show lead in the Devonshire cider and not in the three other counties. Cider specimens derived from lead-lined presses were analyzed and lead was found. In a series of samples tested lead was detected in the Devonshire and not in the Herefordshire cider. Under these circumstances he leaves no doubt that lead was the factor that caused the colic when Devonshire cider was consumed. The truth of Baker's conclusion was confirmed by the lessening of the incidence of colic when the possibilities of lead contamination in the manufacture of cider were removed.

The investigation on the Devonshire colic by Dr. Baker is an outstanding example of epidemiological approach in detecting disease. His hypothesis was suggested by his clinical knowledge of the syndrome produced by lead in cases of plumbism among painters and in cases of poisonous diseases when lead is used medicinally. Therefore, it was unlikely for this syndrome to be produced by more than one agent. By his deductions in seeking the source by incriminating the lead found in the presses with the final critical chemical analysis of detecting lead in Devonshire, he solved the problem of Devonshire colic which was endemic in this part of England for centuries.

In his admirable essay he concludes by

stating, "I have spared no pains in this investigation; and I am insured of my reward in the consciousness of having endeavored to preserve my countryman and fellow creatures from one of the most dreadful diseases incident to the human body."

Let us review another historical instance of the beginning of the machine age and modern industry and the advent and rise of the industrial hygienist, creating a new profession:

The Industrial Revolution

THE MODERN factory system started in England in the eighteenth century as a textile industry, probably due to the fact that that country was engaged in sheep culture, and as a result of a mechanical invention, the spinning jenny, perfected by High Kay and Hargreaves in 1767 and which four years later was supplemented by Arkwright's spinning machine. In 1785 the Cartwright power loom was patented and the first mechanical textile industry was founded. In 1785 James Watt invented the steam engine which with its practical application brought about the mechanical age. England had abundant coal for fuel and iron for manufacturing of machinery and became the foremost industrial country.

Cities began to grow; people flocked from the rural districts, overcrowding hideous and squalid slums; pestilential diseases were endemic; distress prevailed; child labor was exploited; low economic circumstances occurred, and the evils of a new town life became uncontrolled.

The so-called industrial revolution came into existence, and the government had to take action through systematic inquiries and consequent reforms. In 1842 a report on the sanitary conditions of the laboring population was presented to Parliament, and appalling circumstances were revealed. As a result of the classic labors of Edwin Chadwick in reforming these evils, the foundations of sanitary science were laid, thus heralding the organization of modern public health with factory inspection and factory legislation, ultimately to be governed by the Home Office and resulting in the founding of H. M. Factory Inspectors.

Today's well-trained industrial hygienist is the evolution of the factory inspector. He should pay tribute to Chadwick as one of his patron saints.

America patterned herself after England with the advent of steam power and textile machinery. In general, she accepted the reforms and profited by measures in sanitary science, factory laws and inspections promoted by Robert Peel and later by Edwin Chadwick and John Simon.

To review the progress made in your profession: Massachusetts was the first state to legislate a bill in 1852 regarding the safety of steam machines and later boiler inspections. In 1866 a single deputy was detailed by the police department to enforce the law. In 1877 a law was passed giving inspectors the right of entry into factories. Two years later the governor was empowered to appoint two more members to act as inspectors of factories and public buildings. The prescribed duties were: first, the enforcement of laws regulating the hours of labor in manufacturing establishments; second, the enforcement of laws on the employment of children; and third, the inspection of factories and public buildings.

In 1887 an act was passed to secure proper sanitary provisions in factories and workshops and later to secure proper ventilation and meal hours.

In 1888 a separate department of factory inspection was created. Massachusetts must be given the credit for pioneering in factory legislation, factory sanitation, health of workers, accident laws made more drastic, and control and prevention of occupational diseases. All of these have been of inestimable value to the state and have provided the pattern for others to follow and adopt.

Then dawned the twentieth century, the renaissance of modern industry; inventions developed in every field for the betterment of living conditions. The advancements and discoveries in the sciences of physics and chemistry were introduced into the various processes of production. Many of these processes were responsible for evil effects upon the workers and had to be overcome by preventive medical and safety measures, thereby creating a new specialty: industrial medicine, and a new profession: the scientific industrial hygienist.

As to the future: on the eve of the plastic age, radiation and atomic fission, whatever may be in store for industrial medicine and hygiene, assurance is furnished to the worker that we will not falter professionally.

The Industrial Hygiene Organization

—Of the American Can Company—

L. V. TAYLOR,
Supervisor of Industrial Hygiene,
Research Division,
Maywood, Illinois

AS IN allied industries, the manufacturing operations associated with the fabrication of metal and fibre containers may subject some employees to many of the commonly recognized industrial exposures. These exposures have been well classified by Sappington[1] as dusts, vapors and gases, industrial skin irritants, inadequate illumination, undue noises, abnormalities of air pressure, postural strains, abnormalities of temperatures, and infections. The most acute of these exposures in can manufacturing operations are (1) metal dust and fumes associated with the outside soldering of can sideseams, and (2) vapors from the enameling and decorating of plate used in the manufacture of containers.

In spite of the thousands of pounds of solder and the thousands of gallons of solvents consumed annually by the American Can Company in its manufacturing processes, the incidence of occupational diseases among its employees over the past 45 years has been practically non-existent. Even the incidence of contact dermatitis which normally exists to a great extent in many industries employing similar materials is exceptionally rare.

This low incidence of occupational diseases can be ascribed to a number of factors including efficient engineering practices, effective safety practices and devices, and adequate medical control supported by an interest on the part of management to provide good working environments for its employees. Long before the term "industrial hygiene" was commonly applied to the practice of maintaining healthful working environments for employees, all Canco plants were well equipped with extensive ventilation systems and protective devices. For many years, the plants have had the services of physicians, trained nurses and adequate first aid rooms. In more recent years, pre-employment examinations for new employees have been required as well as periodic physical examinations for employees at specified locations in areas where exposures might conceivably occur.

For many years the Research Division has assisted in the conduct of this program. Facilities of this division have always been available for conducting surveys of operations which might be suspected of creating excessive exposures. As far back as 1932, organized studies were being conducted on lead hazards. Shortly thereafter, company tolerances for maximum solvent vapor concentrations in factory air were established and enforced. In addition, many materials proposed for use in the manufacture of containers have been investigated and their safety from the employee as well as from the public health standpoint have been investigated.

More recently, in spite of the exceptional occupational disease record which was established over a period of many years, officials of the company became interested in further improving healthful working conditions in the plants by placing the program on a sounder organized basis. Prior to the recent war, the problem of adequate protection to employee had been largely one of providing adequate protection against hazardous materials, mainly from the standpoint of inhalation and, to a lesser degree, of contact with the skin. In the majority of these instances the maximum quantities of these materials which can be safely tolerated in the atmosphere was determined. Further, studies on materials to find which could be safely used in various manufacturing operations were conducted and methods for control of these various substances were worked out. Lead falls in this category as do the fumes and vapors of many of the organic materials used in large quantities in enameling and lithographing operations.

Changes in the thinking of public health officials, the introduction of many new materials used in enameling and lithographing operations, and the necessary use of substitute materials of unknown characteristics due to government wartime restrictions required increased attention to the program. In addition, wartime necessity for

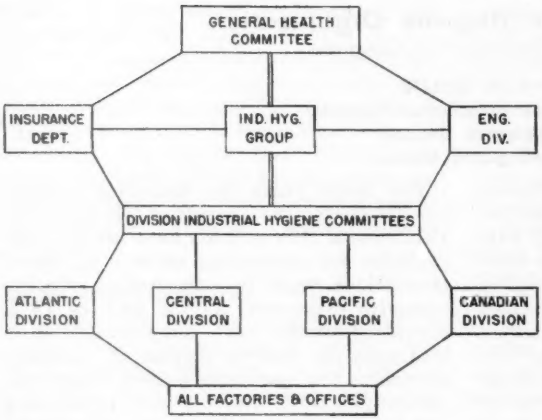

Fig. 1.

decreasing illness, labor turnover and spoilage of materials, as well as improving the health and efficiency of all personnel to meet war production demands, was clearly recognized. Consequently, new consideration was given by company officials in setting up a sustained and workable program which would meet the particular requirements of the company. Large corporations with active and well established programs were consulted. Opinions of public health officials, industrial physicians and industrial hygienists having long years of experience in such activities were also sought.

As a result of these investigations, it was apparent that those corporations having well established health conservancy agencies had one constant similarity, namely, the fact that the health conservancy agencies had direct access to top management. This arrangement is necessary since the complete control of hazardous practices is seldom a function of any one department within any one company. Thus, for example, the health conservancy services may establish that a dangerous condition exists or can be anticipated. Usually, however, it is up to the engineering department to effect correction and up to "Line" organization to enforce the correction. Similarly, other units of large corporations are directly interested in the health conservancy program. Based on American Can Company organization, among these are included industrial relations, insurance, enameling and decorating, purchasing, and research.

After due consideration, it was concluded that all interested units of the company should be in a position to participate in the new health program and still maintain the support of top management. A General Health Committee was therefore established having the Vice-President in Charge of Manufacturing and the Vice-President in Charge of Research and Development as co-chairmen. Other members of the Committee included representatives holding executive positions in the following divisions or departments of the company: manufacturing, industrial relations, insurance, engineering, enameling and decorating and research.

It was early recognized by the Committee that while it was in a position to establish policies and encourage industrial health practices, it would be necessary for it to have the benefit of increased technical assistance. In this connection, the Committee already had at its disposal the benefit of experience with a medical program of long standing as well as the services of an engineering department well acquainted with measures necessary for controlling common industrial exposures. In addition, a well established safety program was already operated for eliminating the so-called obvious exposures or mechanical hazards. Likewise, the technical advice and experience of the research division were available. In the latter case, however, existing personnel was adequate to handle specific requests only but inadequate to devote full time to the problem. Further, it appeared logical to approach the problem by accepting the philosophy of modern medicine which emphasizes prevention over correction. This approach more definitely dictated the necessity for acquisition of sufficient technical assistance to permit continuous and sustained attention to manufacturing operations.

Following the above reasoning, it was concluded that it would be necessary to supplement the available research division facilities with an additional service which, according to modern terminology, would be called *Industrial Hygiene*. Because of the laboratory requirements of such a unit and

also because of the experienced technical personnel already available in the research division, it was concluded that this service should remain as a function of that division. Therefore, a new unit was established in the research division known as the Industrial Hygiene Group. While this group is a component part of the Container Research Section of the research division in so far as salary management and departmental control is concerned, it is guided primarily by the general policies and decisions of the General Health Committee. Of particular importance is the fact that, besides serving as an investigating or fact-finding agency, the group was also established to act as advisor (particularly to the General Health Committee) on all technical phases of the health program. To accomplish this task, it was charged with the responsibility of assisting with physical examination programs and aiding in the establishment of industrial hygiene programs in factories. These activities are beside its most obvious function of investigating the suitability of conditions in the employees' working environment. It was also assigned the task of determining the nature of materials employed or projected for factory operations and establishing safe practices for their use.

In carrying out these functions, as is the case with all industrial hygiene units, the group is specifically concerned with certain factors which might become health hazards under certain circumstances. Such factors, of course, include dusts, gases, vapors, fumes, temperature, humidity and air motion, type of ventilation used, both natural and artificial, the physical set-up of equipment and the types of materials handled with particular reference to their potential health hazards. In addition to the above functions and contrary to most industrial hygiene practices, the responsibility for setting up proper sanitary practices in specific plants is vested in the group.

With the basic organization established, attention was next given to means for promoting the program within the various units of the company. The complexity of this undertaking is more fully realized when it is pointed out that the company operations comprise 54 factories, 47 offices, six warehouses and eight machine shops located in 27 states of the Union, the Hawaiian Islands and Canada. These operations are divided into four divisions, namely the Atlantic Division, the Central Division, the Pacific Division comprising the operations on the West Coast and Hawaiian Islands, and the Canadian Division.

It was not possible to follow precedent in establishing an overall program since the basic type of organization adopted appeared to be a new departure in the approach to industrial health problems. Therefore, rather than to introduce the program on a company-wide basis, it was concluded desirable to confine the operations to one division for the first year. It was felt that information and experience gained during the trial period in this division would supply the pattern which might be followed

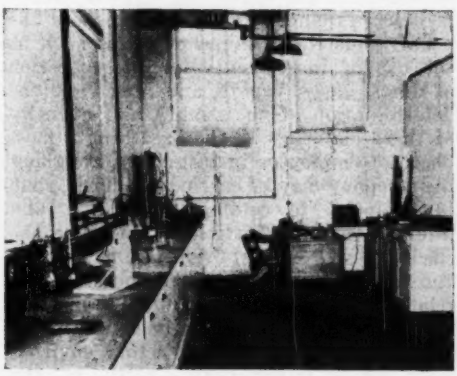

Fig. 2.
Industrial Hygiene Laboratory. Polarograph and General Set-ups for Atmospheric Analysis

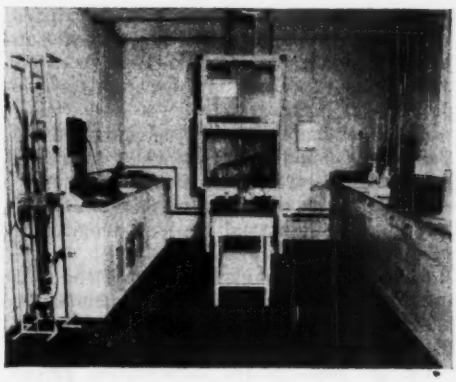

Fig. 3.
Organic Solvent Investigation Set-ups, including Fractionation Column and Abbe Refractometer

throughout the company. The Central Division was selected for this trial period since the main laboratory of the research division was located in that area. Furthermore, located in or near the Chicago metropolitan area in which the laboratory is situated are factories in which practically all of the hundreds of styles of metal and fibre containers are fabricated. This wide variety of operations permitted a convenient location for studying practically all manufacturing practices and materials used in the factories of the company.

To conduct the program in the Central Division and to establish industrial health policies relating to specific problems, a committee was appointed with the general manager of manufacture in the division as chairman. As in the case of the parent committee, this second committee was composed of representatives from the insurance department, industrial relations division, manufacturing division, enameling and decorating division, engineering division and research division.

Following suggestions of the parent committee at the initial meeting of the Division Committee, a general program for the first year was adopted. This program, the responsibility of which rested largely with the Industrial Hygiene Group, is outlined briefly below:

1. Review all work previously done in factories with respect to industrial exposures.
2. Establish a system to obtain full information on all materials used in manufacturing operations both old and new, and determine locations in plants where these are used as well as the quantities utilized.
3. Make reconnaissance surveys of Central Division factories to determine extent of obvious exposures and arrange for corrections, if necessary.
4. Make more detailed surveys of the Central Division factories when suggested by the results of reconnaissance surveys.
5. Determine the best method for popularizing the industrial hygiene program in specific factories.
6. Compile a complete report of the findings accompanied by recommendations based on results and observations for establishing a permanent program.

On the basis of the information gained through the above approach, at the end of the first year the General Health Committee recommended the extension of the program to include the entire company. Therefore, the final organization as adopted is illustrated in the accompanying Fig. 1. Organization and membership of the Division Committee follow a pattern similar to the General Health Committee. In so far as factory programs are concerned it is the policy of the division health committees to permit the factory management to exercise its own perogative in promoting the program and carrying out the policies of the division and general committees. This policy is being followed because of the dissimilarity in the operations of many of the factories and because of the wide variations in the number of employees in plants. Some plants have as few as 100 employees where others employ many hundreds. Although in some of the smaller plants the plant managers are electing to follow the work personally or will assign it to one or two individuals, in most plants specific health committees are being appointed. The most common practice—which is proving to be the most effective—is to have the plant manager act as chairman of a plant committee which is comprised of the general foreman, master mechanic, general maintenance foreman, personnel supervisor, enameling and lithographing foreman and the plant nurse. No set policy has yet been established with respect to frequency of committee meetings. In general, they have been held when and if policies are to be considered or when corrections in operations are indicated.

With the organization established, the personnel of the Industrial Hygiene Group is being expanded to the point where the usual industrial hygiene practices such as the use of instruments for the collection of dusts, gases, vapors, and fumes and the determination of the quality and quantity of these materials in the breathing atmosphere of employees in factories throughout the company may be carried out. The Group is equipped to establish the kind and intensity of illumination, to measure the efficiency of exhaust ventilation systems and natural systems, to make observations relative to temperature, humidity and air motion, and otherwise to give attention to the various factors in the factory environment which might bear directly on the health of workers. By comparing existing conditions with various company standards

established by the Group, it will be possible to make definite recommendations for control of any hazards which might exist.

In addition to the functions described above, continuous research now is conducted by the Group on materials employed or projected for fabrication of metal or fibre containers. In this connection, not only is the safety from the employee standpoint considered but the basic company rule that no materials objectionable to public health officials shall exist in its finished products is also enforced. This has required the study of a wide variety of materials, such as inks, pigments, and waxes.

Results of all factory surveys accompanied by recommendations are being referred to the division health committees for handling of specific problems in the divisions with their respective plants. Recommendations applicable to the entire company are to be referred to the General Health Committee for consideration and dissemination. In addition, all factual information relating to industrial health problems and methods for improving working conditions in plants is assembled by the Industrial Hygiene Group and the information will be disseminated to the various factories in bulletin form through the General Health and division health committees, respectively.

The Canco approach is proving effective and this effectiveness to date can be attributed to the facts that the program has access to top management and that both staff and line management are represented in the program. Through this procedure factual information and recommendations can be placed in the hands of line management for enforcement if or when required. The approach permits improving healthful working conditions in the factories through the services available from the Industrial Hygiene Group to the plants.

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The Education and Training of an Industrial Hygiene Engineer

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WITH THE increasing emphasis on industrial health in our industries it is becoming more apparent that the health program is dependent not so much on the development of technological knowledge in the field but on the development, training, and placing of competent and satisfied personnel.

In the case of the industrial hygiene engineer, whose field is a new one, there inherently occurs because of its newness a mixed opinion as to what constitutes a competent engineer. Consequently, until this question is satisfactorily answered by engineers and management alike, this phase of engineering will be wide open. With this wide variance in qualifications expected from job to job, the compensation certainly will not be commensurate with the education and training required. The compensation of the adequately trained engineer will be unduly influenced by the wages of the lowest trained man using the title. This condition will not attract good engineers and consequently the success of an industrial health program will be endangered.

Inasmuch as it is advantageous to all concerned to clarify this, it is the opinion of the author that a yard stick should be established for engineers and management to use in measuring an engineer's entrance qualification into the field, i.e., education and training. With this well established it will be simply a matter of time before more uniformity exists in the profession. Logically a uniform training will be of great influence on the embryonic engineers desiring to specialize in the field.

The criterion should depend on what is expected functionally of the engineer. First, one must have the technological know-how which can best be insured by didactic education. As to the second, let us call it "public relations," some knowledge can be obtained in the academic curriculum, by extra curricular activities at the University and from enlightened teachers. But by and large, it will come from the school of "hard knocks."

The engineering educational program should be divided in both time and content. The first portion should consist of academic

work in the basic sciences and the second in the professional training and its application to industrial hygiene, particularly the phase of work expected or desired by the student. The first naturally falls into the undergraduate school and the second the graduate school.

Since it is very difficult, particularly in industrial hygiene, for an engineering student to predetermine his course of action at the onset it is pertinent not to integrate one phase into the other to form one course leading to a degree in industrial hygiene engineering although it would perhaps be better didactically.

The basic degree followed by professional training is also superior for financial reasons; e.g., a student can finish the academic portion of his education, receiving a B.S. in some phase of engineering, work for a while and then return to his advanced studies. Noteworthy too with this division, chemists and other non-engineering but technical students becoming interested after contacting industrial hygiene in the field can return for professional training. As indicated, the basic education can best be accomplished by taking an accredited course of study leading to a bachelor's degree in sanitary (civil), chemical, or mechanical engineering. This also provides the engineer a professional status of long standing as opposed to one curriculum leading to a degree in industrial hygiene engineering. Then, at the completion of his professional training, he is not bound to it but can practice his basic engineering should his taste or economic situation suggest it. It is the author's opinion, though he may be ill-advisedly promoting argument, that the industrial hygiene engineer should maintain his parent or basic engineering ties in force even after completion of his advanced training. This could be extended to the title for the present until the qualification and standing of industrial hygiene engineering becomes better established in the profession and in management alike. This should not be construed to indicate neglecting of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION. Another consideration is that quite often in industry the engineer will be required to handle two tasks—one involving industrial hygiene and the other perhaps chemical processing or hydraulics.

The nature of the work of industrial hygiene engineers is highly specific but at the same time covers literally the gamut of subject matter. Essentially the chemical, sanitary and mechanical engineers are well trained to handle certain phases but not the entire field. Therefore, the first process in professional training is to correct the deficiencies of each of the other's field. For example, the sanitary engineer will be well grounded in the techniques of food and premise sanitation, water supply, industrial and domestic waste disposal. It will be necessary to supplement this knowledge with heating, ventilating and air conditioning from the mechanical engineer and the chemical processes involving health from the chemical engineer.

Once each basic education is properly supplemented all students will be in a position to receive the highly specific application of their joint knowledge to matters of industrial health, and as this work proceeds perhaps specialize in one phase or another, possibly the one most closely allied to their basic training; e.g., the chemical engineer specializes in noxious gases, and the mechanical engineer to industrial exhaust systems.

It should be noted too that certain basic foundation work will be necessary. This work springs from the medical portion of the criterion, such as physiology, and ecology. This professional training should include, available to all, the following subjects:

Basic	*Professional*
Heating ventilation	Industrial air analysis
Air conditioning	Industrial hygiene engineering including study of effects, causes and control of (a) Noxious gases (b) Temperature (c) Pressure (d) Fatigue (e) Dust
Ecology	
Water supply	
Waste disposal	
Organic chemistry	Public health administration
Physiology	Safety engineering

Note that safety engineering has been included. This is because now, and more so in the future, the inspectors will come administratively under the industrial hygiene engineer.

It has always been the opinion of the author that the training of competent specialists is not enough and that more "preventive medicine" might be exercised by the exposure of other engineers in industrial hygiene to all engineering material. This can be accomplished best through the media of short courses inserted into standard undergraduate curriculums, the importance of this procedure being only to give each individual sufficient knowledge to recognize industrial health hazards, know where to go for expert advice, and know how to apply it. Certain other engineers should receive more in sanitation; for example, graduate safety or industrial engineers.

So frequently small industries can not justify economically full employment to an industrial hygiene engineer; and some other engineer, perhaps a mechanical engineer in plant engineering, will have matters of health lumped on his shoulders. The technical knowledge will be available to him through the State Board of Health or through consultants, but his will be the job of initial evaluation and administration of the work-a-day recommendations of the experts.

Are Dust Counts Made by Different Laboratories Comparable

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THE improbability of various laboratories obtaining comparable dust counts when different methods of quantification are used has been recognized for some time. It has been stressed from time to time that if one wishes to obtain values which can be compared with previously published dust surveys then it is necessary to copy with considerable care the technique used in the original survey.

With the recognition that dust counts made by different laboratories might vary if different methods of quantification were used, the need for standardized procedures for dust counting became apparent. In 1935-36 the Subcommittee on Standard Methods of the American Public Health Association published a report on methods for sampling and analysis of industrial dusts. Further reviews were published in the 1937-38 and 1940-41 American Public Health Association Yearbooks. Shortly after this, the Committee on Standard Methods of the National Conference of Governmental Industrial Hygienists compiled proposed standard methods for the sampling and counting of fibrosis-producing and similar dusts. This Committee will be referred to later on as the Committee on Standard Methods.

My duties in the field of industrial hygiene have brought me in close contact with several industrial hygienists employed by both governmental and non-governmental agencies. It has been my observation that quite a number of variations in dust counting technique from the proposed standard methods have been allowed to develop. These variations have been estimated by some investigators to account for differences of 200 to 300% between laboratories using different methods. In order to ascertain how universal were these variations in dust quantification technique, I contacted 45 industrial hygiene laboratories representing both governmental and non-governmental agencies.

In comparing the technics used by these different laboratories, I have selected the following as the most important points to be considered:

1. Collecting medium.
2. Type of illumination.
3. Length of time between collection and counting of sample.
4. Types of dust counting cells.
5. Blank determination.
6. Optimum concentration of dust per counting area.
7. Method of counting.
8. Settling time of sample before counting is begun.

The variations found between these different laboratories are as follows:

Fig. 1.
Collection of Dust Sample. Hand-cranked Pump Drawing Air through Small Impinger

No. 1—The Collecting Medium

THE collecting medium is found to vary considerably from the proposed standards of either water alone, or water and alcohol.

Of the 45 laboratories included in this investigation, 39% use water only as the collecting medium, 10% use ethyl alcohol, 6% use n-propyl alcohol, 10% use iso-propyl alcohol, and 35% use either water or a mixture of water and alcohol, depending upon the type of dust being sampled.

Methods of preparing the media for sampling range anywhere from using distilled water from an ordinary metal still or alcohol as supplied by the manufacturer to triple distillation from all-glass distilling apparatus.

The collecting medium should be chosen for its ability to wet the dust particles and for its inability to dissolve them. Low viscosity and low volatility are also desirable qualities or lesser important in so far as collection of the sample may be concerned.

For dusts such as limestone which are slightly soluble in water or for dusts that tend to flocculate, alcohol has been found to give more consistent results than if water is used.

On the other hand, where resins are encountered, water with the addition of a wetting agent might be suitable. Obviously, the use of one standard collecting medium is not feasible and those who use one collecting medium only are likely to obtain low counts if the dust is soluble to any extent in the medium.

No. 2—Type of Illumination

LIGHT FIELD illumination is generally accepted as the standard technique. Of those laboratories which I contacted, 41 use light field illumination, one uses annular dark field illumination, and three use both.

Those laboratories using both light field and dark field illumination do so to obtain information on size properties of the dust and on the number concentration of the particles revealed by the dark field procedure, particularly where dusts of unusual

Fig. 2.
Small Impinger. Air Being Drawn through at Rate of One Tenth Cubic Foot per Minute

fineness are encountered. The ratio between dark field and light field counts has been found to vary from 2 to 1 to as much as 100 to 1, on various types of dust. Take one case for example, reported by the Bureau of Industrial Hygiene of the City of Detroit. In this particular case the men were working with powdered talc which produced an enormous dust exposure. Dust samples were collected and the collecting liquid was milky in appearance. When this liquid was transferred to a counting cell and examined with the usual light field optical system the count was practically zero as the particles were below the resolving power of the objective. When examined with dark-field illumination the count was extremely high. This, of course, represents an extreme case but certainly indicates that unless the same type of illumination is used for a specific dust there will be a wide variation in the reported dust concentration. Also, this may possibly represent one weakness of our current procedure and may indicate the need for revising our present

system to provide for special cases such as this.

No. 3—Time Between Collection and Counting of Sample

THE standard dust sampling and counting technique proposed by the Committee on Standard Methods specifies that the sample shall be counted within 36 hours after collection except that in the case of flocculating dusts the permitted holding time shall not exceed 12 hours. This pre-supposes the collection of the dust in a water or water-alcohol mixture.

Of those laboratories included in this survey who used water or water-plus alcohol as a collecting medium, 89% adhered to a maximum of 36 hours and none allowed over 48 hours to elapse between the collection and counting of the sample. Of those laboratories using alcohol, whether ethyl, n-propyl, or iso-propyl, the majority of them reported that most dust samples could be kept for several days without any noticeable solubility or flocculation. This is of particular importance where the samples are sent back to one central laboratory for counting. In general, most laboratories adhere to a strict policy of counting the samples in as short a time as possible and the difference in counts from this source is slight. However, such dusts as those from foundries containing iron and steel when collected in water should be counted in a very short time in order to prevent "rusting."

Here some variation in dust counts between different laboratories may be expected to occur unless these laboratories use exactly the same time between collection and counting of the samples.

No. 4—Types of Dust Counting Cells

SEVENTY-NINE (79) per cent of the laboratories included in this survey use the Sedgwick-Rafter cell or other cells 1 mm. deep such as the Dunn Cell and M.S.A. cell, 6% use the Hatch Cell of 1/4 mm. depth, and 15% use various types of blood or mold counting cells of 1/10 mm. depth with reported comparable results. The advantages of the blood counting cells over the conventional 1 mm. cell are reported to be ease of cleaning, shorter settling time, elimination of the Whipple disc, and the fact that the 1/10 mm. depth places most of the particles in focus without much raising or lowering of the objective. On the other hand, a much smaller amount of liquid is used for this type cell and greater care must be exercised in filling the cell. Also, where low dust concentrations are encountered in the atmosphere, a much longer sampling time is required. The general experience has been that dust counts made with the blood counting cells are comparable with those obtained using the conventional type cell except possibly where low concentrations of dust are encountered.

No. 5—Blank Determination

FORTY (40) per cent of the laboratories included in this survey maintain their blank counts within the maximum of six countable particles per 1/4 sq. mm. counting area recommended by the Committee on Standard Methods. Twenty-eight (28) per cent allow a maximum blank count of

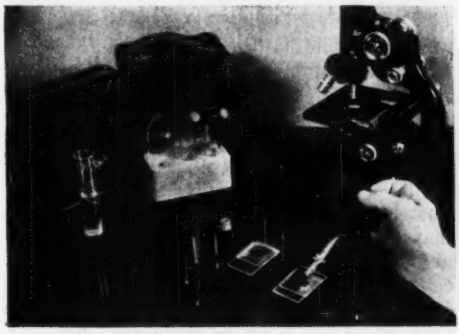

Fig. 3.
Transferring Sample of Dust Suspended in Distilled Water to Dunn Counting Cell

Fig. 4.
Counting Dust Particles at 100 Diameters Magnification with Light Field Illumination

10 particles, 12% allow a maximum blank count of 15 to 20 particles, and 20% do not adhere to any maximum limits.

The practice of carrying the "blank" impinger tube into the field is adhered to by all but a few of the laboratories. The necessity of this practice, however, is questioned by some, inasmuch as it is their contention that any contamination in the field cannot be assumed to be uniform, and they prefer to take extreme precautions against contamination by tightly stoppering the impinger tubes and washing them on the outside before opening them for counting purposes. Certainly the same holds true in limiting the blank count to a low maximum number of particles. Keeping the blank count very low necessitates careful handling of the collecting media and sampling tube and is therefore much more likely to give final counts representative of the dust in the air and not that from careless handling of the impinger tubes.

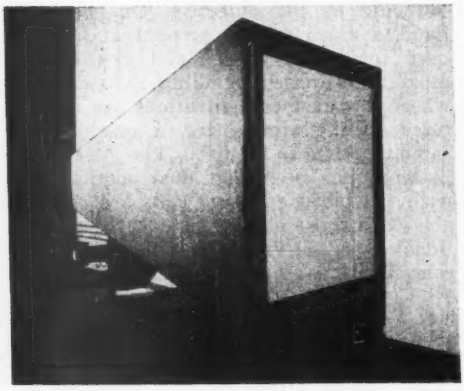

Fig. 5.
Microprojector for Dust Counting on Illuminated Screen

No. 6—Optimum Concentration of Dust per Counting Area

CONSIDERABLE differences of opinion exist as to what constitutes an optimum concentration of dust per counting area. Opinions vary from a maximum of 20 to a maximum of 250 particles per 1/4 sq. mm. counting area.

Of those laboratories using the standard 1 mm. cell, 28% adhere to a maximum concentration ranging from 20 to 50 particles per 1/4 sq. mm., 47% observe a maximum of 50 to 100, and 20% allow a maximum concentration of from 100 to 250 particles per 1/4 sq. mm.

The general consensus of opinion arrived at from actual experience by many of these laboratories is that if dust concentrations are allowed to exceed 100 particles per 1/4 sq. mm. the counting is more difficult, more time consuming, and the smaller particles are more likely to be missed in the counting, due to overlapping, aggregation, etc. It has been the experience of some laboratories that for any given sample the count progressively increases, within certain limits, as the dilution of the sample is increased. It is to be expected, therefore, that those laboratories adhering to a maximum of perhaps 50 particles per 1/4 sq. mm. counting area, all other factors being equal, will obtain a greater reported dust concentration than those laboratories using a maximum concentration of 250 particles per 1/4 sq. mm.

No. 7—Methods of Counting

SIXTY-THREE (63) per cent of the laboratories included in this survey count only those particles that have settled in a single plane near the floor of the cell, the only adjustment of the microscope being a slight raising or lowering of the objective to bring individual particles into focus. Counting of suspended particles is stated by these laboratories to be inaccurate, difficult, and very time consuming.

On the other hand, 37% of these laboratories count the particles throughout the entire depth of the liquid.

Some laboratories are of the opinion that all the dust visible with the accepted optical system should be counted whereas others are of the opinion that it is not practical to determine the equilibrium count or count throughout the depth of the liquid and therefore use a reasonably short settling time and count in one plane on the bottom of the cell only. Such dusts as coal, organic dusts, asbestos, mica, and several others, may require several hours for all the countable particles to settle to the floor of the cell. Obviously, with dusts of this nature counts made by different laboratories will vary widely as long as these two different methods of counting are used.

Where cells 1/10 mm. deep are used, prac-

tically the entire depth of the cell can be seen when the bottom of the cell is in focus and consequently this factor does not affect the total count as greatly as in the case of those cells 1 mm. deep.

No. 8—Settling Time

THE length of time the sample is allowed to settle in the cell before counting is begun, together with the two different practices of counting either in one plane or throughout the depth of the cell probably constitute the greatest source of difference in counts made by different laboratories.

There are three different schools of thought responsible for this wide variation in settling time and in the method of counting.

First, there are those who believe in the practice of allowing the sample to settle a reasonably short period of time and then attempting to count all the particles which are both suspended in the liquid and settled in one plane on the bottom of the cell chamber; second—those who subscribe to the practice of allowing the sample to settle for an exact period of time and then counting only those particles which have settled in one plane on the bottom of the cell chamber; and, third—those who determine the equilibrium count on each sample by making counts on the bottom of the cell at various intervals, which often requires several hours, until the dust suspension has reached a point of equilibrium.

The length of time the samples are allowed to settle in the counting cell before counting is begun varies greatly between the different laboratories.

Of the laboratories using cells 1 mm. in depth, the various periods of time allowed for settling of dust in the cell and the number of laboratories using these various settling periods are as follows:

1	laboratory	exactly 5 minutes;
1	"	approximately 6 minutes;
1	"	approximately 10 minutes;
1	"	exactly 15 minutes;
11	"	exactly 20 minutes;
3	"	exactly 30 minutes;
1	"	exactly 60 minutes;
4	"	minimum of 20 minutes and maximum of 30 minutes;
2	"	minimum of 20 minutes and maximum of 40 minutes;
1	"	minimum of 30 minutes and maximum of 60 minutes;
6	"	approximately 20 minutes but settling time not observed very closely;
4	"	approximately 30 minutes but settling time not observed very closely;
3	"	from 20 minutes to several hours.

The settling time allowed by various laboratories for the blood counting cell or similar cells 1/10 mm. deep is much shorter but even here the time varies from one minute to as much as 15 minutes.

Of the laboratories using an exact settling time and where this settling time is the same for all types of dust, 78% count only those particles in one plane on the floor of the cell as compared to 22% that count the particles throughout the depth of the liquid.

The rate of settling of any particle depends upon such obvious factors as weight and surface area of the particle and the viscosity and specific gravity of the liquid. For a given type of dust and collecting medium this settling rate is fairly constant but this may vary considerably where various collecting media are used and different dusts are encountered. It should be quite obvious then that the use of different collecting media and different settling periods will give different dust counts.

Some dusts which are uniform in size and composition and which settle rapidly do not present a very serious problem in so far as settling time is concerned, and whether the count is made at the end of 20 minutes or 40 minutes will make no great difference in the final results. On the other hand, those dusts which are composed of individual components that vary greatly in size and composition and which tend to settle slowly, will show a marked difference in counts if different settling times are used.

The following tables indicate the effect of variations in settling time on several types of dust.

Table 1 represents dust from the fettling of green pottery ware. The composition of the dust was the same in each case but the concentrations were not the same. Therefore, no comparison of the actual counts should be made between the two. The increase in the dust count in Case A of the sample collected in water from a count of 24 particles per ¼ sq. mm. at the

TABLE 1.

Type dust: Pottery dust before firing
Type counting cell: M.S.A. 1 mm deep
Method of counting: In one plane, bottom of cell chamber

A. Collected in Water

Settling time	*Count per ¼ sq. mm.*
20 minutes	24
30 minutes	36
40 minutes	49
60 minutes	71

B. Collected in n-propyl alcohol

Settling time	*Count per ¼ sq. mm.*
20 minutes	28
30 minutes	48
40 minutes	64
60 minutes	92

end of 20 minutes to a count of 71 at the end of 60 minutes meant a difference of 196% between the two different settling times.

In the case of the sample collected in alcohol, the increase in count from 28 to 92 particles of dust per ¼ sq. mm. for the same period of time made a difference of 225%.

Counting, as indicated, was made in one plane, on the bottom of the cell chamber and the same method was used for all cases where the effect of settling time was being observed.

TABLE 2.

Type dust: Pottery-bisque fired ware
Type counting cell: M.S.A. 1 mm deep
Method of counting: In one plane, bottom of cell chamber

A. Collected in water

Settling time	*Count per ¼ sq. mm.*
20 minutes	66
30 minutes	84
40 minutes	88
60 minutes	92
2 hours	97
6 hours	96

B. Collected in n-propyl alcohol

Settling time	*Count per ¼ sq. mm.*
20 minutes	105
30 minutes	125
40 minutes	125
60 minutes	150
2 hours	167
6 hours	167

Table 2 shows the effects of settling time on the same type pottery dust as in Table 1, except in this case the ware had been bisque-fired. In this case, also, the dust concentrations of the two were not the same. The increase in count in the case where water was used as the collecting medium was from 66 at 20 minutes to 92 particles at 60 minutes, or 39%, and the increase for the same time where alcohol was the collecting medium was 43%.

As indicated by this table, this particular type dust required two hours to reach equilibrium, both where alcohol was the collecting medium and where water was used as the collecting medium.

The total increase from 20 minutes to two hours was 47% for the sample collected in water and 59% for the one collected in alcohol.

TABLE 3.

Type of dust: Wall tile, before firing
Type counting cell: M.S.A. 1 mm deep
Method of counting: In one plane, bottom of cell chamber
Sampling medium: Water

Settling time	*Count per ¼ sq. mm.*
20 minutes	40
30 minutes	46
40 minutes	47
60 minutes	54
16 hours	118

Table 3 represents dust from the fettling and trimming of green wall tile. The increase from 40 particles per ¼ sq. mm. at the end of 20 minutes settling time to a count of 54 at the end of 60 minutes made a difference of 35%. The increase, however, from 20 minutes to 16 hours was 195%.

Some laboratories have a policy that if during counting, successive fields show a tendency to increase in count they then allow the sample to settle longer before counting. In cases such as this one if the counts were made between 30 and 40 minutes the increase was negligible and the sample could have been assumed to have settled sufficiently. However, from 40 minutes to 16 hours the count increased 71 particles per ¼ sq. mm. counting area.

TABLE 4.

Type dust: Ball clay
Type counting cell: M.S.A. 1 mm deep
Method of counting: In one plane, bottom of cell chamber
Sampling medium: Water

Settling time	*Count per ¼ sq. mm.*
20 minutes	98
30 minutes	141
40 minutes	146
60 minutes	160

TABLE 5.

Type dust: Porcelain enamel dust
Sampling medium: n-propyl alcohol
Type counting cell: M.S.A. 1 mm deep
Method of counting: In one plane, bottom of cell chamber

Settling time	*Count per ¼ sq. mm.*
20 minutes	46
30 minutes	44
40 minutes	46
60 minutes	49

The increase in this case of ball-clay dust from 98 particles per ¼ sq. mm. at 20 minutes to 160 particles at the end of 60 minutes made a difference in count of 63%.

In Table 5, of porcelain enamel dust the particles were of fairly uniform size and composition. The increase in count from 20 to 60 minutes was only three particles per ¼ sq. mm. counting area, an increase of 7%.

With dusts of this type which settle rapidly, the length of settling time before counting is begun does not present as great a problem as do some other types of dust.

TABLE 6.

Type dust:	Raw mix, for porcelain enamel frit
Sampling medium:	n-propyl alcohol
Type counting cell:	M.S.A. 1 mm deep
Method of counting:	In one plane, bottom of cell chamber

Settling time	*Count per ¼ sq. mm.*
20 minutes	179
30 minutes	219
40 minutes	241
60 minutes	299
6 hours	538

Table 6 is used to show the differences in behavior of the finished porcelain enamel dust shown in the preceeding table and the raw materials for porcelain enamel frit shown in this table.

The increase in this case from a count of 179 per ¼ sq. mm. at 20 minutes to a count of 299 at the end of 60 minutes made a difference of 67% as compared to an increase of 7% for the porcelain enamel dust for the same period of time.

The total increase in count from 179 particles at 20 minutes to 538 particles at six hours made a difference of 200%.

With some laboratories counting throughout the depth of the cell, others counting in one plane but using various fixed settling times, and still others determining the equilibrium count on the dust samples, it is quite obvious from these few cases that as long as so many different settling periods are used dust counts made by these different laboratories will vary considerably on many types of dust.

There is no doubt that dust counting technics in general vary widely between laboratories and consequently dust counts made by these laboratories are quite often not comparable.

Perhaps one of the reasons for our difficulties lies in the fact that we have attempted to establish one rigid standard method for the quantification of all dusts. Possibly dust should be classified into several different groups according to their physical, and optical properties and certain standard modifications established for each group. Certainly the quantification aspects of the dust problem demand standardized procedures, particularly if we expect results obtained by one laboratory to be comparable with those of another.

Conclusion

THE data obtained indicates a decided lack of uniformity in dust counting technics between different laboratories and further thought should be given to clarification and standardization between laboratories.

The following suggestions might be taken as a starting point for further work on clarification and standardization of dust counting procedures:

1. The nature of the dust being collected should determine the collecting medium to be used rather than using one collecting medium for all types of dust. If the dust is soluble in water or tends to flocculate, then an alcohol should be used for collection. On the other hand, if the dust is soluble in alcohol, then water or water plus a suitable wetting agent should be used.

2. Much has been said as to the relative merits of light-field versus dark-field illumination. However, since we are not so much concerned with making an absolute measurement of the dust in the air but instead are interested in a reproducible index of the dustiness of the air and since light-field illumination is used by most of the laboratories it would seem wise to continue to use light-field illumination for all standard dust counting.

3. The length of time allowed to elapse between collection and counting of the sample should be kept at an absolute minimum. If it is necessary for the sample to be kept for several days before counting, which might be the case if the dust samples are sent in to one central laboratory, then for fibrosis-producing dusts as an example, the sample should be collected in undiluted alcohol (either ethyl, n-propyl, or iso-propyl) rather than water.

4. The conventional Sedgwick-Rafter cell or other cells 1 mm. deep is still the choice of the majority of laboratories. Some laboratories report excellent correlation of counts between cells 1 mm. deep and shallow

cells such as the haemocytometer whereas others report that for certain dusts it is difficult to obtain good correlation. In changing from a cell 1 mm. deep to one 1/10 mm. deep it is advisable to make check counts using both type cells until comparable results are obtained.

5. The blank count should be kept at a very low figure, preferably under six (6) countable particles per ¼ sq. mm. counting area in the cell. This insures that reasonable care has been exercised in preparing and subsequently handling the collecting media and sampling equipment.

6. The concentration of dust per counting area should be at least four or five times the "blank" count and preferably not more than 100 particles per ¼ sq. mm. counting area. It has been the experience of various investigators that if the count much exceeds 100 particles per ¼ sq. mm. counting area that counting becomes very time consuming and quite often inaccurate. In cases where the concentration exceeds 100 particles per ¼ sq. mm. it has been found preferable to further dilute the sample and prepare new cells for counting.

7. Counting in one plane on the floor of the cell chamber is to be preferred to counting throughout the depth of the cell. Experiences of various investigators have indicated that it is more difficult for different persons to obtain comparable results when counting throughout the depth of the cell than when counting in one plane only.

8. Much has been said as to the length of time the sample should be allowed to settle in the cell before counting is begun. Some laboratories use a fixed settling time whereas others allow the sample to settle until in their estimation all the particles have settled. Consequently we find settling times for cells 1 mm. deep varying from five (5) minutes to sixteen (16) hours. Inasmuch as we are more interested in a method of counting that will give reproducible results rather than attempting to count all of the particles, it would appear practicable to employ a fixed settling time for all dusts. A settling time of exactly thirty (30) minutes for cells 1 mm. deep and five (5) minutes for cells 1/10 mm. deep would seem most desirable in that this allows a large percentage of the easily counted particles to settle to the bottom of the cell and still this settling time is sufficiently short as to allow a reasonable number of samples to be counted during the day.

Notes on Ventilation of Grinding and Other Foundry Operations

H. H. VALIQUET,
Ventilation Engineer,
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OPERATION of exhaust ventilation in grinding operations with unsatisfactory results may be due to a number of causes. Among these is the clogging of the housings with slag. When this occurs dust particles are returned to the operator's breathing zone.

As an approach to the solution of this difficulty, a modified pipe trap may be suggested. A small orifice, high velocity pick-up can be located beneath the steady rest. Velocities through an opening—1½ x 4 inches are practical dimensions—of the order of the peripheral speed of the grinding wheel will usually be necessary. Such a flow of air will cool the stream of sparks much more quickly and prevent slag difficulties. I have observed the slag building up to a point where this rapid cooling by air movement definitely occurred and the dust stream was under ventilating control. This includes breathable particles which streak along with large ones.

Another difficulty to be overcome is the recirculation of dust by fan action of the wheel. The following of wheel wear by adjustment of the cut-off plate at the top front opening of the hood and closing the wheel clearance at the sides will do this and make for safer and more complete control of the breathable dusts both of the nuisance and injurious types. The housing should have one-inch clearance on sides of wheel.

Hood design has been defined by state codes, in one instance calling for 1,200 fpm. velocity and in another 1,400 fpm. velocity through the face opening to hood. I believe the speed of coarse dust particles is much

greater than these values. These particles must be controlled. Such is my purpose in proposing high velocity pick-up.

When sufficient data have been accumulated, coefficients of grinding hoods may change, even be increased, and ventilation made more effective. This approach to the problem has been suggested by the use of a high velocity slot in a re-saw with air inrush equal to saw travel.

Again, in buffing-trash control where aluminum was finished with rag wheel, speeds in excess of 11,000 feet per minute are to be suggested. Retaining such a mass of waste material in the air stream calls for uninterrupted flow from buff to orifice disposal. This means air velocity from 7,000 to 10,000 feet per minute for grinding operations.

The enclosing of the dressing tool for twin grinding of ends of springs and partial top covering on surface grinding has taken us a long step forward on the path of dust elimination, without excessive ventilation due to indirect contact.

Dust particles can be deflected into enclosures by sloping the edge of hoods forward. This works well on the hood edge of vertical disc grinders beneath the movable work table. High speed coarse-particle travel carries trains of breathable dust with it; deflecting the large, often incandescent, particles also influences the control of the small ones. Ventilation at 500 feet per minute minimum velocity can take over when the dust nuisance is brought within its reach. I find that the Wisconsin code of minimum curtain of air is too low for grinding.

I have tried to use compressed air at high velocities to deflect the coarse particles to a side hood opening on swing grinders but gave up in failure, as the coarse particle projection cannot be easily stopped.

The composition of the dust collected while grinding malleable iron as well as sand-blasting of cast iron is of interest. Eighty-seven per cent of the grinder dust was steel, 13% other material such as silicon carbide or non-magnetic dust. In a sand-blast room, 18.3% of the dust was magnetic metal, 81.7% sand from the spent abrasive.

The ventilation at the front opening of certain abrasive-blast equipment has been found to be about one half the 100 feet per minute air velocity deemed necessary for loading dirty hard-iron malleable castings. This fact has been noticeable when covers are leaky and dust clouds escape into the breathing zone.

My tests showed 250 feet per minute through such an opening permitted only about 2,000,000 countable dust particles per cubic foot of air breathed by operators while loading. This increase in ventilation requires larger vent pipe connection and not higher velocities at pipe openings to plague the operator by increased abrasive loss.

Tumblers are not dusty if ventilated with 5,000 feet per minute air velocity through hollow trunnion and exhaust pipe, both of same size. Three inches minimum total suction head is about right for expanded stream line type of trunnion.

The straight bore trunnion should run with higher suction, about 4 in. On the basis of considerable test data, as low as 13% of available total head was found to be velocity head in the trunnion.

The best result on another design showed as high as 61.2% useful velocity head. This is the ratio of velocity head to total available head of air. Whether the barrel was loaded or empty made little difference in this ratio.

Tumblers can be clean with no fine dusty refuse dumped onto the floor beneath traps or sifting from leaks, and the time for tumbling can be appreciably reduced with adequate ventilation.

Outside air may be used in tumblers or air recirculated to conserve heat as is done with properly designed sand-blast cabinets and rooms. The operator stands outside of a curtain. I do not include sandblast rooms in these suggestions. This requires adequate dust elimination such as occurs in the cloth stocking collector or other equally efficient type of arrester. Sufficient air is discharged out of doors to assure a positive inward flow through cracks and curtain openings. It may be possible to do this on blast table dust control but careful tests should first be made to assure that dust exposures are kept within safe limits.

The muller ventilation should include the skip hoist. An air curtain should be provided at point of loading, and air should be exhausted through the top of the muller. We are going beyond reason when we produce more air changes in mullers than

would be reasonably correct for a sand-blast room. The elimination of large leakage areas through which dust can escape from the muller will permit a minimum of air volume handled in the control of the dust exposure.

Sand conditioning can best be controlled by enclosing each screen or magnetic separator and applying exhaust ventilation.

The shakeout problem can be solved with provision of side hoods with exhaust ventilation at the rate of 250 to 300 cubic feet per square foot of screen shakeout. The subsurface or pit shakeout reduces the volume of air removed as also does completely enclosing the equipment. With such control, effectively designed, low dust counts are obtainable.

In the furnace area, especially in melting steel, hoods reduce dustiness considerably. Much dust and fumes are thrown into the air, mostly oxides of metals, by furnaces without hood ventilation.

In conclusion I want to make one truth perfectly clear: grinding wheel ventilation is no longer in the era of speculation; methods of successful control are today well developed.

Presidential Address

ROBERT A. KEHOE, M.D.,
President,
The American Industrial Hygiene Association

THE deeply appreciated honor of holding the highest office in one of the organizations which meet here today, gives me an opportunity to address my colleagues and fellow-members in two of them, and perhaps in others as well. It is to both of the organizations officially represented on this program that I wish to speak. If I seem to emphasize the importance of greater understanding of certain problems, on the part of physicians, it is because, as a physician, I can do so without professional discourtesy or lack of grace.

The professional people who are gathered together here have cause to rejoice that the disastrous war which has disrupted so many of our activities including those which characterize these meetings, is now a thing of the past. On behalf of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION I greet our membership and the members of other organizations represented here. On this occasion we might all be disposed to breathe a sigh of relief, to settle down in an atmosphere of good fellowship and mutual congratulations, and to relax a bit in the feeling that the most difficult period of our joint activities is now behind us. During the war the significance of good health and stamina on the part of those engaged in industrial production came to be much more apparent than it had ever been before. Our field of professional endeavor was recognized, and was also more clearly defined. Our coming of age, in the professional sense, has been accomplished to a degree, by the only means which, in other phases of human life, differentiate adolescence from adult stature—that is, by the acceptance and discharge of responsibility in relation to a necessary task. We found the task, and, to the best of our abilities, we performed it, and with reasonably satisfactory results.

Let us consider our situation carefully, however, before we allow ourselves to relax too much. We have much work and searching ahead of us before we shall have visualized our job clearly and learned how best to go about it. We have yet to achieve that synthesis of our professional disciplines and responsibilities that should eventually weld us into a unit which can plan together and act with competence to achieve our joint purposes. It is neither necessary nor desirable to stifle the competition between the several groups who contribute to the promotion of industrial health. It is of the greatest importance, however, that these groups should work together in mutual understanding and respect and not disperse their several energies in opposing each other. The collective representation of physicians, physiologists, biochemists, analytical chemists and engineers in the membership of the American Association of Industrial Hygiene gives concrete evidence that this situation has been recognized to a de-

Presented at a Joint Meeting of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS and the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, Chicago, April 10, 1946.

gree, and the holding of this joint convention and the planning of joint programs are matters of similar import. However, there is room for doubt that our situation is appreciated as it should be and must be. Let me ask two questions that may give point to my skepticism. To what extent has it become the accepted practice to organize the facilities and personnel concerned with safety and health, in industrial plants and in industries as a whole, into a coordinated unit? Where have means and facilities been provided for the instruction of those who are to engage in this field of work, either in the fundamental or practical sense? These are very simple questions, and they are by no means all that might be posed. However, I venture to suggest that few of us can give an answer to either that will be reassuring. We are in fact dealing with a rather new concept, and, to be sure, we must proceed with patience and also with a degree of caution, proving our ground as we go. There are reasons for hope and even for enthusiasm, not only because of what has been accomplished, but, in much greater measure, because of what can be done. On the other hand, this is no time for smugness or self satisfaction. Neither the physicians, nor their more recently acquired colleagues who practice other arts and disciplines in this field, have acquired the knowledge, the skill, or the point of view that is necessary to protect and promote the health of our industrial population and to develop this priceless asset to the full. Nor are there adequate facilities for the research and professional instruction that would cultivate such knowledge and pass along effectively such knowledge and the skill to which we have referred. In short, we have not achieved the professional position to which we aspire, nor shall we be able to do this and to deserve the respect which the scope and importance of our field of endeavor justify, until we have pooled our interests and professional resources, clarified our minds as to our mutual needs and potentialities, and established the correlative disciplines of both instruction and practice that will produce the industrial hygienist of the future whether physician or engineer or some combination of both.

To make matters clearer, we may indulge in a bit of over simplification. As a group facing the same general problem, industrial hygienists are concerned with the industrial environment, in the broadest sense of the word, on the one hand, and the response of human beings to environmental conditions, on the other. The environment, whether office or assembly line, is to be understood in all of its aspects, and in so far as it is necessary and wise to do so, as determined by the needs of the human mechanism and personality, it is to be controlled. Knowledge of the various characteristics of the environment can be obtained in any effective sense, only through the combined efforts of the physicist, chemist, engineer and physiologist (using the latter term in its general sense). The human response to the environment is within the province of the physiologist, but here also the assistance of the physicist and chemist are required; and unless the variegated pattern of this response is properly studied and interpreted, all attempts at modification or control will be futile and may be disastrous.

It must be apparent, therefore, that broad information as to the environment and the human response thereto is the foundation upon which all the work of industrial hygiene must depend.

Now in general practice, the study and control of the industrial environment, in the specific instance, is regarded as the responsibility of the industrial hygiene engineer, while the interpretation of the human reaction is the job of the physician. Because of this conventional division of labor, we are tending more and more to separate these two functions as completely as possible in matters of training, experience and organization. The result is certain to be disagreement, professional strife and the dissatisfaction that follows failure to achieve the desired result. Neither group can accomplish its purpose without an understanding of the fact that the character of the environment and the response to it constitute only opposite facets of the same problem. One is non-existent without the other, and both are so deeply rooted in human physiology as to be utterly inseparable.

There is, therefore, a basic training and a fundamental viewpoint which must be achieved by all who expect to take an intelligent and effective part in setting up the policies and procedures which make up

the day's work. On this common ground of thinking, the physician and the industrial hygiene engineer (to use a term that may not be apt but will convey our meaning) can apply their various specialized techniques with all the ingenuity and competence which each can muster and with the mutual benefit that attends the adaptation of varied means to a common end.

Until means shall have been evolved for providing the necessary type of training whereby a new generation of industrial hygienists will come into being, there are certain general principles which we who work in this developmental period might well bear in mind. These principles are very simple. Our goal is not the expansion of professional prestige. Rather it is the improvement of the health and well-being of our industrial population. If we accomplish that we shall have all the recognition that we require to gain the necessary financial and social backing for our work. We must be on the alert to learn everything that will facilitate this improvement. We physicians cannot ignore any call for medical service on the part of the injured and ill, but we must not fail to recognize that our primary job in industry is to so understand man and his environment as to prevent his illnesses and injuries, and to promote his health and happiness. Our colleagues, the industrial hygiene engineers, can help us greatly in acquiring this knowledge. These associates, on the other hand, must not scorn the clinical and physiological knowledge of the physicians, incomplete and imperfect as it may be at times, and must not think they can handle the environmental problems without regard to what can be learned about the human equation. Engineering methods of control, as our clinical means of study, are merely the tools of our respective trades. Both must be applied together, in joint humility because of our combined ignorance, and yet in mutual respect, because of what has been and can be done by each for the other.

Mercury Exposures: Evaluation and Prophylaxis

—Notes from the Industrial Health Conference, Chicago, April 7-14, 1946—

Reported by

C. O. SAPPINGTON, M.D., Dr. P.H.

MR. E. C. BARNES gave a paper on "Determining the Concentration of Mercury in the Air."

'Mercury as a vapor or as a dust from its compounds has been recognized as a potential industrial health hazard and its maximum allowable concentration has been established as 0.1 milligram of mercury per cubic meter of air. For the past eight years a method for determining total mercury concentration in the air has been used by our laboratory. The sample of mercury is collected from the air with a standard impinger, operating at one cubic foot per minute, and using a KI-I_2 sampling solution. The sampling solution consists of 0.25% I_2 in 3.0% water solution of KI. It is prepared by dissolving the KI in a small volume of water, adding the I_2 and then making up to the proper volume. Some of the KI-I_2 solution is used for rinsing the impinger to avoid dilution with water.

'The quantity of mercury is determined by a colorimetric comparison of the unknown sample with known standards. Five ml. of the sampling solution containing the mercury are placed in a 50 ml. Nessler tube and 1 ml. of a 10% $CuSO_4$ solution added. This is mixed well by gentle shaking, 2 ml. of 3N Na_2SO_3 are added and the gentle shaking continued for one-half minute. A flocculent suspension results which is white if there was no mercury present and a pink-orange color if mercury was present.

'The total volume of sampling solution is determined and 5 ml. transferred to a 50 ml. Nessler tube. The two reagents are added to develop the color and make a preliminary estimate of the amount of mercury. A dilution is made if necessary to being the amount of mercury in 5 ml. of the solution within the optimum range of standards, and 5 ml. again placed in a Nessler tube for the final analysis.

'The optimum range of standards is between 3 and 20 micrograms of mercury in the 5 ml. of solution, although this range can be extended to between 1 and 100 micrograms with reduced accuracy. Color standards for comparison with the unknown are prepared by placing known amounts of standard mercuric chloride solution from a 5 ml. microburette in the 50 ml. Nessler tubes, adding measured quantities of the KI-I_2 solution to make the

Newly Elected Officers

—American Industrial Hygiene Association—

Left to right: President-Elect, LIEUT.-COL. T. F. HATCH, Head of Membership Relations, Industrial Hygiene Foundation of America, Inc.; President, FRANK A. PATTY, Head, Industrial Hygiene Department, General Motors Corporation; Secretary, LIEUT.-COL. ALLEN D. BRANDT, Sc. D., in charge of Industrial Hygiene, Bethlehem Steel Corporation; Treasurer, CARLETON E. BROWN, Sc. D., Health and Safety Section, U. S. Bureau of Mines; Past-President, ROBERT A. KEHOE, M.D., Director, Kettering Laboratory of Applied Physiology, University of Cincinnati, College of Medicine.

total volume equal to 5 ml. and then adding the other reagents. A standard mercuric chloride solution containing 10 micrograms of Hg/ml. is made up in KI-I_2 solution (.25% I_2 in .3% water solution of KI). A standard containing 0.100 mg. Hg/ml. of KI-I_2 solution is first prepared and it is then diluted 1-10 in KI-I_2 solution.

'Efficiency of the method was found to be above 90% when air containing mercury vapor was drawn through two impingers in series and the samples in the two impingers were analyzed by this method. The efficiency was above 98% when tested in the same manner against mercuric oxide dust. After the solutions have been made up, the analysis of several samples can be completed in less than an hour.'

DR. BRADFORD N. CRAVER presented a paper on "Prophylaxis Against Mercury-Induced Ventricular Fibrillation."

Prophylactic medication for inhibiting the toxic manifestations that may result from inevitable exposures in industry to noxious materials is a comparatively new concept. Its applications thus far are few, but research should increase their number. Protective coatings for preventing the development of contact dermatitis in work that the complete avoidance of exposure is impossible or impractical are well-known. Vitamin C has been given to workers exposed to lead in the hope that the effects of mild, chronic exposure might be counteracted thereby. Such a hypothesis is difficult to test. The report of Marchmont-Robinson (1941) was favorable but others have not been, so a final judgment would appear to require further data. The use of aluminum therapy for both the treatment and prevention of silicosis, as initiated in 1937 by Denny and his co-workers, and independently by Gardner and his collaborators rests on firm ground. More recently, BAL (British Anti-Lewisite) has been administered to workmen unloading arsenic trioxide. The results have been encouraging but whether one is justified in administering such a potentially toxic material as BAL under these conditions awaits proof.

Further studies in this type of industrial prophylaxis should prove fruitful.

This concept of prophylaxis is comparatively new to industrial hygiene but centuries old for medicine, since the problems in the latter field are different, more individualized and much easier of treatment. Such a problem was recently brought to attention by the report of Pines and his associates (1944) that magnesium sulphate simultaneously injected with a mercurial diuretic, the sodium salt of pyridine-dicarboxy-β-mercuri-ω-hydroxypropylamide-theophylline (Esidrone), could prevent the acute toxic manifestations in animals that al-

ways occur when the dose is sufficiently large, to wit, cardiac disturbances leading finally to ventricular fibrillation in fatal cases. Their complete review of this problem, as well as their excellent justification for their use of magnesium sulphate is available in their paper and need not be considered here. Efforts to confirm their results, thus far unavailing, even though widely variant doses of magnesium sulphate administered by various routes have been employed, nevertheless have led to several interesting results. A surely fatal intravenous dose in a dog was determined to be 15 mg/kg. of Esidrone based on the mercury complex alone and disregarding the weight of added aminophylline. This was determined for dogs anesthetized with sodium pentobarbital (nembutal). Unanesthetized dogs could withstand that dose with few, if any, untoward effects. The choice of anesthetic, however, markedly influenced the toxicity of the Esidrone. With diallylbarbituric acid plus urethane (Dial) anesthesia, the dogs could tolerate three to four ordinarily fatal doses of 15 mg/kg., given at one-half hour intervals, before developing ventricular fibrillation. Ether will be tried to determine what influence it may have. It is well known that the choice of anesthesia in an acute experiment is important and may significantly alter the results.

Thus, Ramsey and her associates found in dogs that the fatal dose of digitalis per kilogram varied from 0.94 cc. of tincture for dogs anesthetized with ether to 1.30 cc. tincture for dogs with sodium pentobarbital.

The administration of 0.2 mg/kg. of atropine sulphate 15 minutes before the administration of the Esidrone protected the animal for three to four fatal doses. Vagal section, on the other hand, gave little or no protection so the parasympathetic action of the Esidrone, if such it be, must be peripheral and not central. That would suggest that parasympathomimetic drugs such as eserine or acetyl - - methylcholine (Mecholyl) might increase the toxicity of Esidrone. These results will be reported later.

It is hoped we may be able to study the detoxifying action of BAL against Esidrone even though it is recognized that should such detoxifying action be evidenced, as it probably will be, a corresponding action against the drug's desired therapeutic effect, diuresis, would probably also result.

Attempts to abort the preterminal cardiac irregularities after fibrillation had appeared were made.

Intracardiac injections of epinephrine saved some animals that would surely otherwise have died. Other drugs will also be tried for this purpose.

Personal Notes

ALLEN D. BRANDT, SC.D., Lieutenant Colonel, U. S. Public Health Service, and Secretary of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, is to be associated with DR. LOYAL A. SHOUDY, Chief of Medical Service, Bethlehem Steel Corporation, to be in charge of industrial hygiene. BRANDT was assigned by the U. S. Public Health Service to the Safety and Security Branch of the Office of the Chief of Ordnance during the war to direct occupational disease control in munitions plants and other establishments under the Ordnance Department. Following the war, he was assigned to the Research Laboratories of the American Society of Heating and Ventilating Engineers at Cleveland, Ohio, where he has been engaged in fundamental research work on characteristics of exhaust ventilation hoods. He takes up the duties of his new connection with the Bethlehem Steel Corporation as of July 1, 1946.

MR. HERBERT S. WALWORTH has recently become Industrial Hygiene Director of the Lumbermens Mutual Casualty Company with headquarters in Chicago. WALWORTH was previously with the Detroit Industrial Hygiene Division and in charge of technical phases with the Montana and the Tennessee Health Departments, Divisions of Industrial Hygiene.

MR. WILLIAM E. MCCORMICK has recently joined the staff of the Industrial Hygiene Service, Georgia Department of Public Health. While on active duty for the past three years with the U. S. Public Health Service, he had assignments at the National Institute of Health, Bethesda, and more recently with the North Carolina State Board of Health.

DR. NUNZIO J. CAROZZO, Staten Island, New York, has been assigned from the U. S. Public Health Service as acting medical director for the Iowa State Division of Industrial Hygiene.

MR. A. T. ROSSANO, JR., U. S. Public Health Service, recently Director of the Division of Industrial Hygiene, Colorado State Board of Health, Denver, has been appointed to a similar position for the Division of Industrial Hygiene of the Alabama Department of Public Health.

DR. WILLIAM G. FREDRICK has been appointed Director, Bureau of Industrial Hygiene, Detroit Department of Health, and will assume his new post July 1. He will succeed MR. WILLIAM WITHERIDGE, who has become associated with General Motors.

AMERICAN
INDUSTRIAL HYGIENE
ASSOCIATION
QUARTERLY

Official Publication
Warren A. Cook, Editor

Vol. 7 June, 1946 No. 2

Teamwork

TO THE members and friends of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION: In my capacity as current president of your organization I have the pleasant duty of addressing each of you through the medium of this first copy of our new periodical. The inauguration of this QUARTERLY marks the culmination of a desire to have our own publication for dissemination of current industrial hygiene information and news, and for guiding the progress that is being made and will yet be made in our profession. The A.I.H.A. is now in its eighth year and, despite its youthfulness, after scarcely emerging from a lusty infancy, it is faced with the necessity for assuming greater responsibilities. Our country's need and desire for our services is still acute; we have been given the ball—we dare not muff it. There is urgent need to clarify our thinking and our work—we need this medium of expression of ideas from all groups of our composite membership. We have equal need to continue and expand the scientific research aspects of industrial hygiene, covered by the *Journal of Industrial Hygiene and Toxicology*, which is planning to assume the status of official organ of the A.I.H.A. in this field. For both of these tasks we have a hard-working, efficient, experienced Editorial Committee with a big job to do—let's each one give them all the help we can every time we can.

Every professional man finds it to his advantage to promote the development of the profession which furnishes his livelihood. A.I.H.A. has an enviable record of accord and achievement in bringing together persons interested in the various phases of industrial hygiene and in increasing the knowledge of industrial hygiene. Because of that it is to our advantage to foster and make more complete the membership of the A.I.H.A. Since we always get back something akin to what we put into anything, we should welcome every opportunity to add what we can to the project. It is to our advantage to see that interested and eligible persons have an opportunity to join our Association, especially physicians, ventilation engineers, nurses, physicists, bacteriologists, and others who may have been engaged in some phase of industrial hygiene for several years but perhaps have not realized that they are eligible for membership. Let's lend a hand to the Membership Committee.

The majority of us have been too busy with our daily tasks to take much interest in portraying to others, or even among ourselves, the scope of our field of endeavor or in establishing an educational standard for industrial hygiene personnel. Few if any of us are expertly qualified in all of the ramifications of the field, and there perhaps is not even a concerted opinion of exactly what this field embraces. We are sometimes prone to place our particular specialties high in order of importance and minimize or ignore the things in which we are not well versed. The scope must be clear in our own minds before we can define it for others.

The question has been asked whether industrial hygiene includes medicine, nursing, toxicology, sanitation, ventilation, nutrition, housing, and certain other specialties in industrial public health. It has even been suggested that a degree in medicine should be a prerequisite for a course in industrial hygiene. Educators, and more especially would-be educators, are in somewhat of a quandry about terminology and educational standards and qualifications.

It has thus become necessary for someone to develop terminology and standards and set up the goals so that industrial hygiene may be taught as a profession, as well as that the best orientation courses may be given for physicians, nurses, toxicologists, bac-

teriologists, physicists, architects, and other interested persons. It is important that this be properly initiated in order that such education may have a sound foundation for growth and expansion.

Serious thought has already been given to this problem by organizations in the fields of public health and industrial medicine. It seems reasonable to think that the persons who are now engaged in industrial hygiene activities should have the most adequate and complete understanding of what they are doing, its relative importance, and what, if anything, should be added to their present activities. Even though an individual so engaged may not have all of the qualifications desired in an industrial hygienist, if he has been doing this work very many years he should be able to appreciate the necessary and desirable qualifications for the job, what should be taught, by whom, where, and the necessary prerequisites. Since our organization is open to men and women from the arts and sciences, who have been engaged in any phase of industrial hygiene for three years or more, it is perhaps not presumptuous to suppose that the majority of such actively interested persons are members, or may become members. It seems logical therefore for A.I.H.A. to sponsor the effort to establish these points of terminology, professional standards, and desirable curriculums. To this end our Committee on Education and Terminology is dedicated—they need and will appreciate all your ideas.

The Local Sections Committee has a double-barreled job—constructing a model constitution for local sections, and fostering the development of additional local sections. If you are interested in forming a section of the A.I.H.A. in your locality, let them help you.

If you want a job or are looking for qualified help, take your problems to the Personnel Placement Committee. It's not a large Committee, but I have a hunch you'll be hearing from it.

Our Program Committee chairman has already started thinking about next year's program. He will be expecting a contribution—better start planning a paper now.

Industrial hygienists, in common with other human beings, like to gripe now and then. I'm sure that our able secretary will see that all complaints receive consideration by the proper persons; and if the business supports it, we will provide additional personnel and start a gripe department. Let's have your gripes.

We would not close this A.I.H.A. "broadcast" without a word of appreciation to our good friends and colleagues the A.P.H.A. and the A.A.I.P.S. who have provided a home for our individual pioneer members and nurtured the infant A.I.H.A. through the period of its conception, birth, and definition. We need and will be heartened by the continuing cooperation and help of your older—perhaps wiser—heads, individually and collectively.

FRANK A. PATTY, President.

Association Publications

ARRANGEMENTS completed by the A.I.H.A. Board of Directors have now fulfilled the needs of the Association for official publications to handle its several requirements. The *Journal of Industrial Hygiene and Toxicology* has long held an eminent position in the presentation of papers on scientific research and abstracts covering the entire field of industrial hygiene and will continue to fill this position as an official publication of the A.I.H.A. From the beginning of the Association, the more general papers in the field together with news of A.I.H.A. activities have appeared quarterly as a supplement to INDUSTRIAL MEDICINE. For a number of years there has been an increasing demand on the part of the members for an entirely separate journal of our own—to serve as the organ of the Association. This demand is now met by this journal, the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION QUARTERLY, which is in reality the continuation, under its own covers, of a periodical now in its seventh volume. This publication will continue to grow in value and interest with the expansion of the Association, and of the field of industrial hygiene itself.

New Executive Secretary

INCREASED activities of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION have necessitated the office of Executive Secretary, provided for in the Constitution, be filled on a part-time basis. The Board of Directors has appointed to this position, LEON I. SHAW, PH.D. DR. SHAW received his B.S. in Ceramics at Alfred University, M.S. at Syracuse University, and Ph.D. at the University of Wisconsin. He served as assistant chief chemist at the U. S. Bureau of Mines through the first World War and recently retired from his position as development engineer, Western Electric Company, Hawthorne Works. Industrial hygiene activities were under his direction at this large plant. DR. SHAW brings a valuable experience to the A.I.H.A. resulting from his constructive participation in the development of Alpha Chi Sigma, national chemical fraternity, through which he has long been well known to many of the chemist and chemical engineer members of the Association. He has also been active in the American Ceramics Society, and is a fellow of the American Association for the Advancement of Science and a member of the American Chemical Society, American Society of Testing Materials, and Sigma Xi. DR. SHAW is returning to Alfred University to direct a new research project in ceramics. His present address, which will now serve as the official address of the A.I.H.A., is Box 793, Alfred, New York. The Association is fortunate in having as its first Executive Secretary, a man of long contact with the field of industrial hygiene, extensive experience in association activities, and a sufficient interest in this organization and its aims and purposes to undertake this assignment.

American Industrial Hygiene Association
News of Local Sections

Chicago Section

ON FEBRUARY 20, 1946, DR. L. E. HAMLIN, Medical Director, American Brake Shoe Company, Chicago, spoke on "Significance of Dust Exposures in Grinding Operations" and MR. H. H. VALIQUET, Ventilating Engineer, Employers' Mutual Liability Insurance Company, Milwaukee, talked from his broad experience in the ventilating of grinding machines and other foundry equipment.

At the March 20 meeting, a panel discussion was presented on compensation phases of occupational diseases. "Procedure in Handling an Occupational Disease Claim" was discussed by WILLIAM BOWE, Attorney; FRANK R. PEREGRINE, Attorney; C. O. SAPPINGTON, M.D., D.P.H., Industrial Health Consultant; and ALFRED J. BORAH, Chairman, Illinois Industrial Commission. DR. SAPPINGTON concluded the meeting with a paper on "Tuberculosis as a Compensation Problem."

The Industrial Hygiene Session of the Midwest Safety Conference held in Chicago on May 9, 1946, was organized by the Chicago Section. With WARREN A. COOK, Chairman of the Chicago Local Section, presiding, the following program was presented:

"Solvent Vapor Exposures from Common Industrial Operations"—FRANK A. PATTY, Head, Industrial Hygiene Department, General Motors, Detroit.

"The Supervisor's Responsibility in Industrial Hygiene"—C. F. BURRIS, Safety Manager, International Business Machines, Endicott, New York.

"Purchasing Department Opportunity in Occupational Disease Prevention"—ANDREW H. PHELPS, Vice-President in Charge of Purchasing, Westinghouse Electric, East Pittsburgh.

"Exposures in Hand Soldering Operations Through Use of Iron, Pot and Torch"—G. WALKER DAUBENSPECK, Industrial Hygiene Engineer, Division of Industrial Hygiene, Illinois Department of Labor, Chicago.

On May 22, 1946, CLARK D. BRIDGES, Director of Conservation Services, Zurich Insurance Companies, talked on "Physical Factors in Job Placement." MR. BRIDGES, whose book, "Job Placement of the Physically Handicapped," has just been published by McGraw-Hill, emphasized the industrial hygiene relationships to this problem. The sound-slide film "Ability to Work" illustrated MR. BRIDGES' talk and clearly demonstrated that, though a person may have a number of physical handicaps, there is still in most cases more ability than disability if proper placement procedures are utilized.

On June 19, 1946, the subject, "A Comprehensive Health Program in Industry," is to be covered by members of the staff of the International Harvester Company. The annual business meeting of the Section is to be held at this time.

Georgia Section

ON MARCH 11, DR. R. A. KEHOE, Kettering Laboratory of Applied Physiology, University of Cincinnati Medical School, discussed lead exposures before the Georgia Section. The discussion of lead was particularly timely and pertinent at this meeting in view of the fact

that the battery plants and lead smelters of the state apparently have been attempting to develop more adequate medical programs and more complete environmental controls within individual plants.

Michigan Section

A DINNER meeting of the Michigan Society was held in Detroit on April 25, 1946. The speaker of the evening was BRUCE H. DOUGLAS, M.D., whose subject, "Tuberculosis and Industry," was of interest to all who attended. DR. DOUGLAS has been Commissioner of the Detroit Department of Health for the past five years; a Member of the Tuberculosis Commission of the National Research Council; and Professor of Preventive Medicine and Public Health, Wayne University College of Medicine and Surgery.

On May 20, 1946, ROBERT T. LEGGE, M.D., of Berkeley, California, was the principal speaker at the dinner meeting held at the Masonic Temple in Detroit, before the Michigan Society. The subject of DR. LEGGE'S talk was "The Historical Background of Industrial Hygiene." DR. LEGGE'S long activity in industrial hygiene and his authoritative position in the field make his presentation of especial interest not only to this local section but also to the entire membership of the Association. His paper is accordingly being published elsewhere in this issue.

Metropolitan New York Section

THE March meeting of this Section, which was held at the Lower East Side Health Center, New York City, was addressed by four speakers who discussed the following topics:

"Effects of High Radioactive Intensities"—DR. BRADFORD N. CRAVER, Senior Pharmacologist, Ciba Pharmaceutical Products, Inc., Summit, New Jersey.

"Exposure to and Control of Halozone"—DR. NATHAN MILLMAN, Director, Office of Industrial Health, Long Island City, New York.

"A New Type of Dust Collector"—MR. H. J. HERSEY, JR., 15 Park Row, New York.

"Solvent Exposure in Shoe Manufacture"—DR. SAMUEL MOSKOWITZ, Senior Chemist, New York State Department of Labor, New York.

The Industrial Hygiene Session of the Greater New York Safety Council was held on April 10 at the Pennsylvania Hotel, New York City. ARTHUR C. STERN and LEOPOLD SCHEFLAN, officers of the New York Section A.I.H.A., served as Chairman and Vice-Chairman, respectively. The program follows:

"Industrial Hygiene Plant Survey: Its Purpose"—MR. J. C. RADCLIFFE, Chief, Bureau of Industrial Health, New Jersey State Department of Health, Trenton.

"Ventilation Control of Occupational Disease Exposures"—MR. JOHN M. KANE, American Air Filter Company, Louisville, Kentucky.

"Other Control Measures for Occupational Disease Exposures"—MR. FREDERICK W. SANDS, Industrial Hygienist, United States Rubber Company, New York City.

On May 16, the meeting was addressed by DR. H. H. SCHRENK, Chief, Health Division Bureau of Mines, U. S. Department of Interior, Pittsburgh, on the subject, "Respiratory Protection for the Exposed Worker." DR. SCHRENK'S long experience in the development of test procedures for approval of respirators makes his observations on this subject authoritative. This talk was illustrated by the picture, "The Air We Breathe," developed by the Mine Safety Appliances Company.

Northeast Ohio Section

ON JUNE 13, 1946, an organization meeting was held in Cleveland to form a new section of the A.I.H.A. to include persons interested in industrial hygiene in northeast Ohio. MR. FREDERICK S. MALLETTE, in charge of industrial hygiene and toxicological investigations for the Firestone Tire and Rubber Company, Akron, was elected Chairman, *pro tem.*, and MR. H. G. DYKTOR, Director, Division of Industrial Hygiene, Cleveland Health Department, Secretary-Treasurer, *pro tem.*

Pittsburgh Section

A REGULAR meeting of the Pittsburgh Section was held at the U. S. Bureau of Mines Auditorium on Tuesday, January 29. MR. E. C. BARNES, of Westinghouse Electric, talked on "Sampling and Analysis of Chlorinated Hydrocarbon Gases and Vapors." The sound slide film, "The Air We Breathe," was shown.

St. Louis Section

ON FEBRUARY 21, 1946, DR. W. J. SEIBERT, Pathologist, De Paul and Lutheran Hospitals, talked on the subject "Toxic Effects of Carbon Tetrachloride and Allied Substances."

On March 21 the St. Louis Section saw the Mine Safety Appliances Company's film, "The Air We Breathe." Following the presentation of the picture there was an open discussion on respiratory protective devices and their uses, covering problems and experiences.

Washington-Baltimore Section

ON MAY 7, DR. WARREN F. DRAPER, Deputy Surgeon General, U. S. Public Health Service, talked on the subject, "Public Health Experiences in the European Theatre of Operations," at the Officers Club, Naval Gun Factory, D. C., to the great interest of the members of the Section.